

Experiment 1 Preliminary Work

Diodes and Rectifiers

Ahmet Akman 2442366

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1 Introduction

2 Step 1

Notes on signal generators, oscilloscopes and multimeters are studied and reviewed the fundamentals.

3 Step 2

Notes on diodes document is studied. The datasheets of the diodes to be used in this experiment are reviewed, which are [1N40007](#) , [BA159](#) ,[AA119](#) ,and [BZX55C-6V2](#).

4 Step 3

In this step characteristics of linear modeled junction diodes are analyzed according to the I vs V equation as follows,

$$I = I_s [e^{\frac{qV}{nkT}} - 1]$$

Ideality constant n is taken 1 for both cases. From explanation in the manual $\frac{kT}{q}$ is taken as 25 mV at temperature (20°C) . The common piecewise linear model for a junction diode is given in Figure 1.

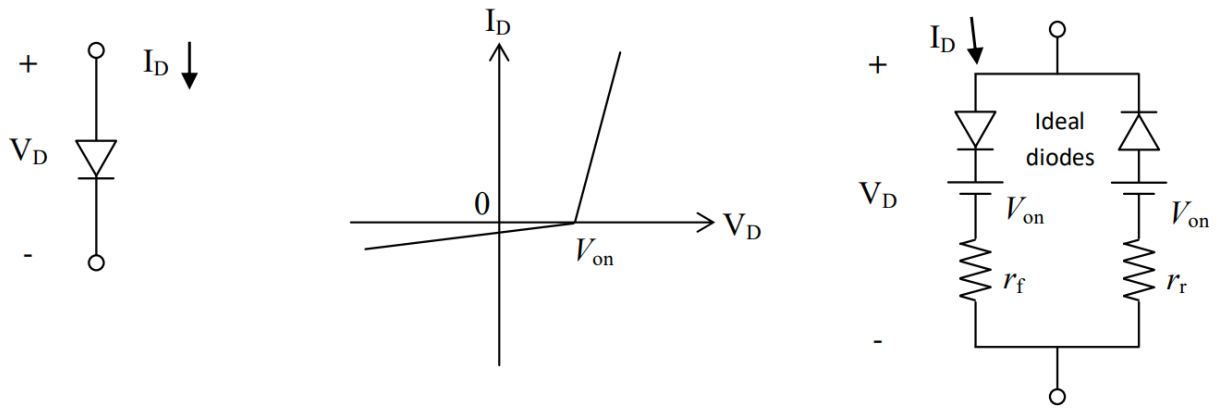


Figure 1: Common piecewise linear model for a junction diode.

4.1 a)

Table 1: I vs V

V(Volts)	I (Amps)
-0.40	-2.499999718662063e-07
-0.20	-2.499161343430244e-07
0	0
0.10	1.339953750828606e-05
0.20	7.449894967604320e-04
0.30	0.040688447854751
0.40	2.221527380126968

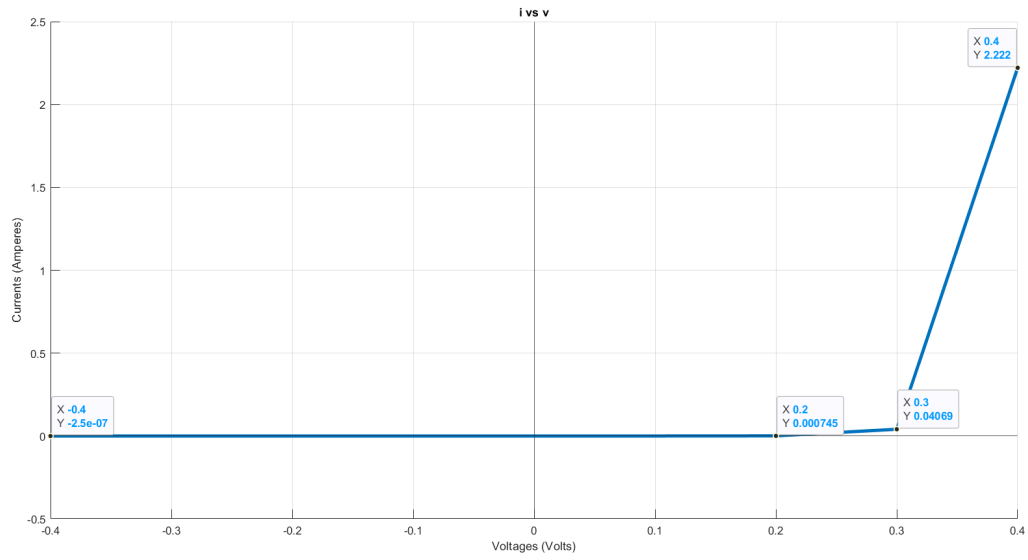


Figure 2: i versus v plot

4.2 b)

Table 2: I vs V

V(Volts)	I (Amps)
-0.40	-9.999998874648254e-16
-0.20	-9.996645373720976e-16
0	0
0.20	2.979957987041728e-12
0.40	8.886109520507873e-09
0.50	4.851651944097903e-07
0.60	2.648912212884338e-05
0.70	0.001446257064290
0.80	0.078962960182680

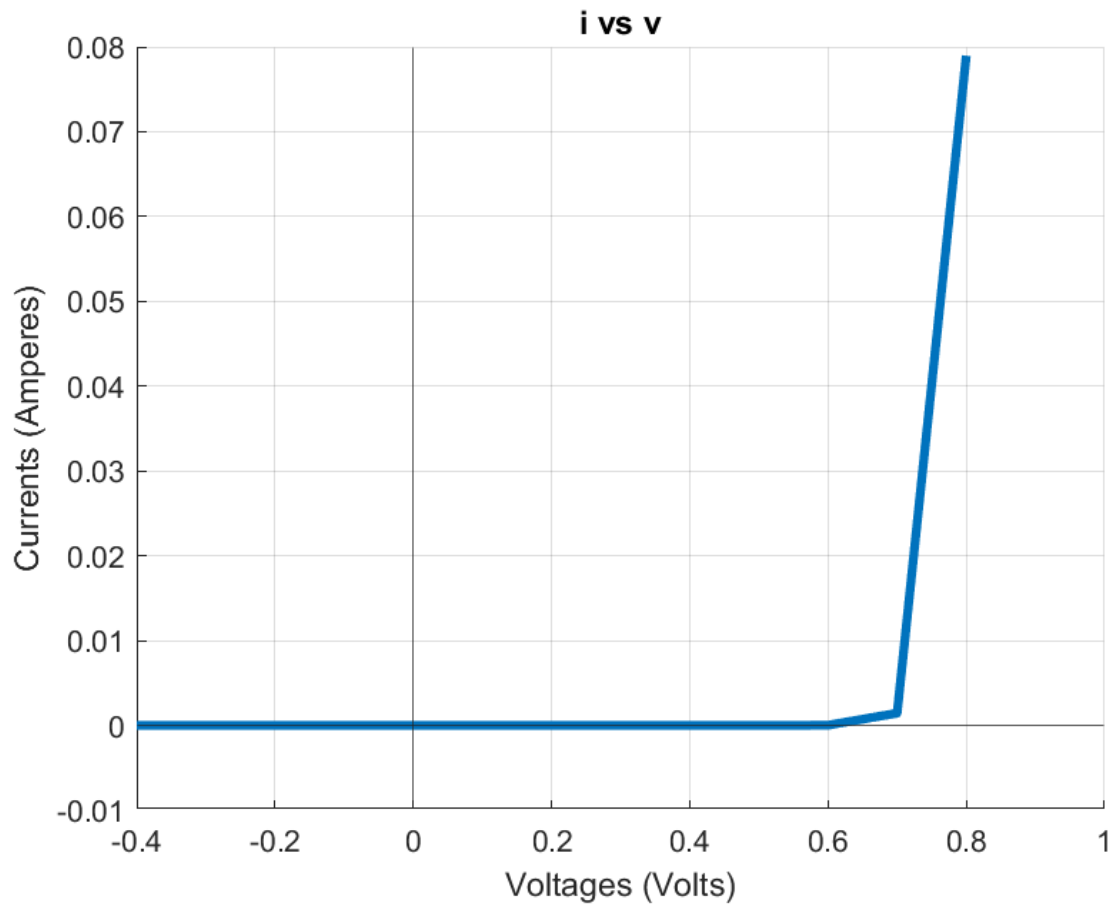


Figure 3: i versus v plot

5 Step 4

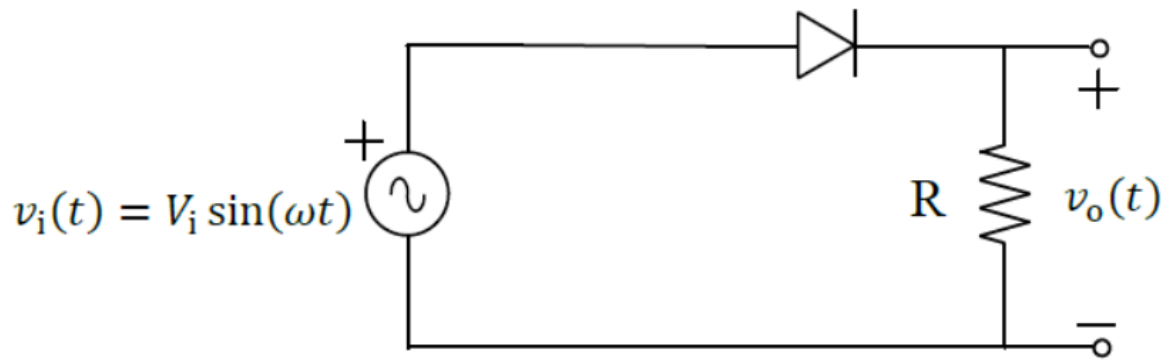


Figure 4: Half-wave circuit schematic for the Step 4

6 Step 5

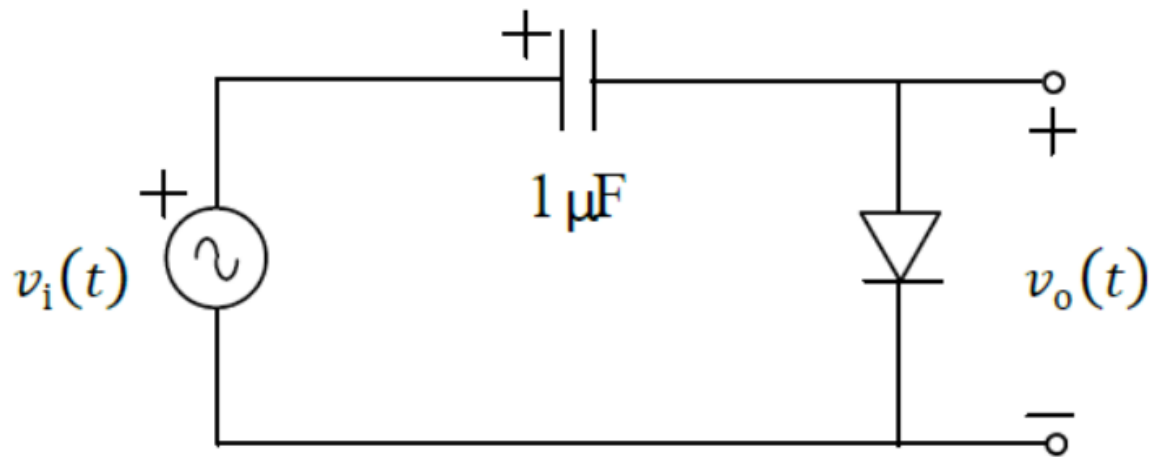
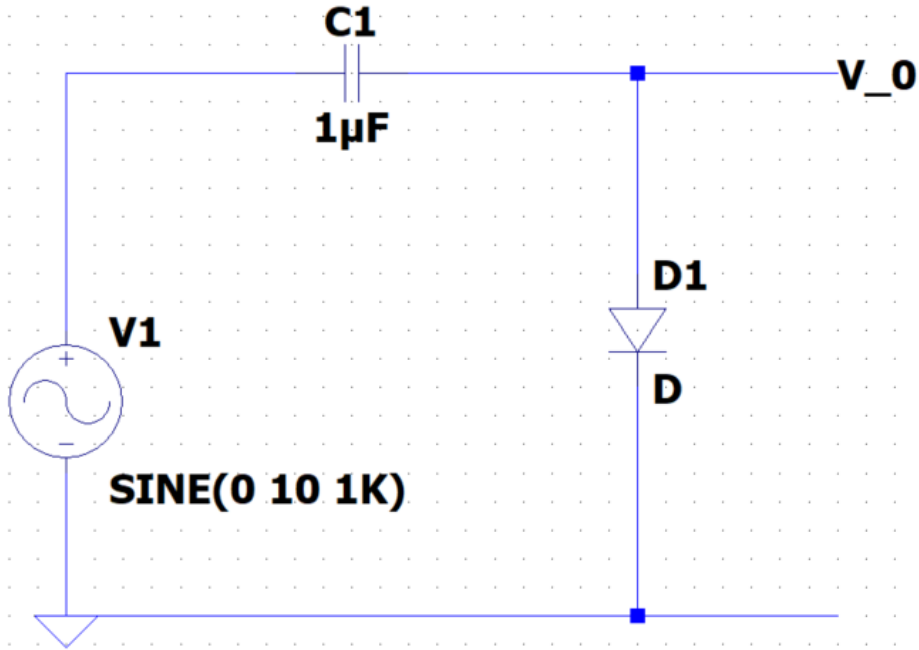


Figure 5: Diode clamper circuit schematic for the Step 5



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Figure 6: Diode clamper circuit simulation schematic for the Step 5

6.1 a)

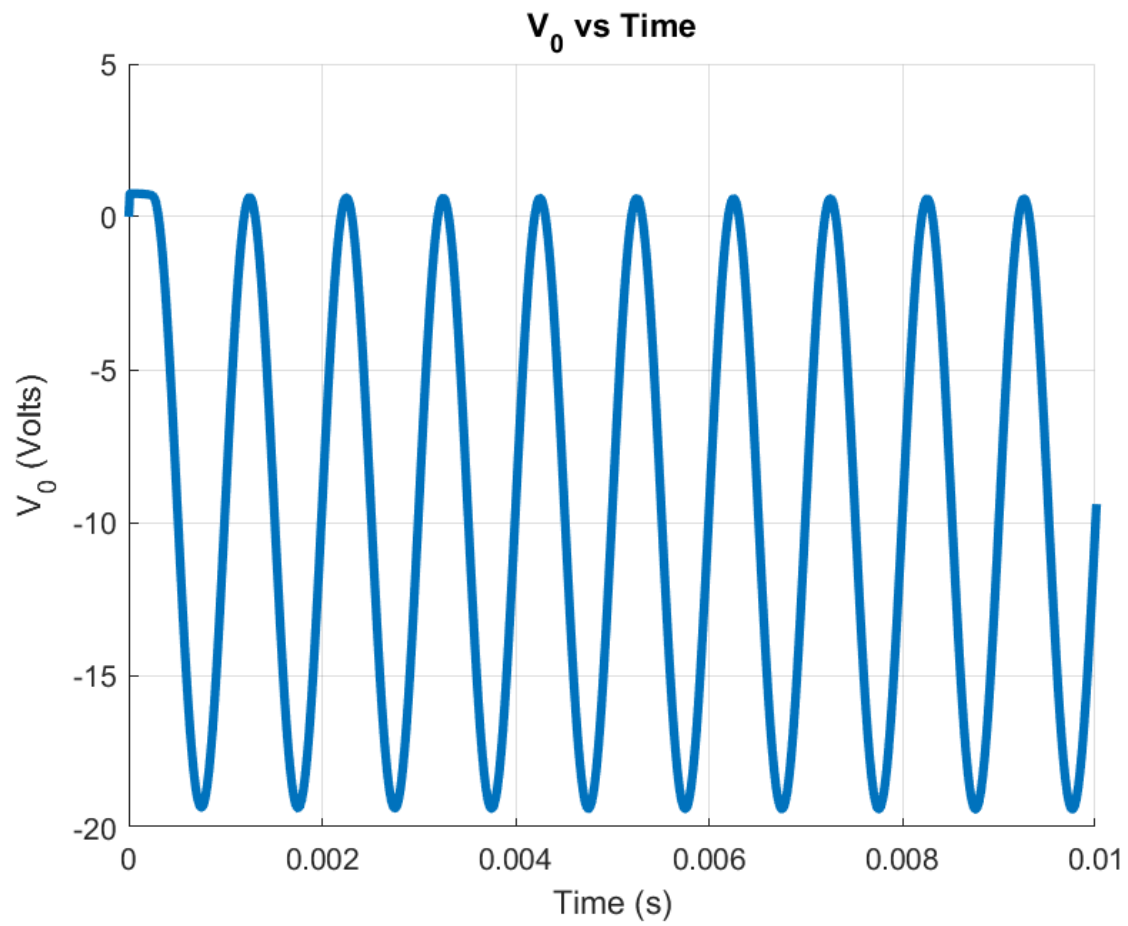


Figure 7: Diode clamper circuit simulation plot

6.2 b)

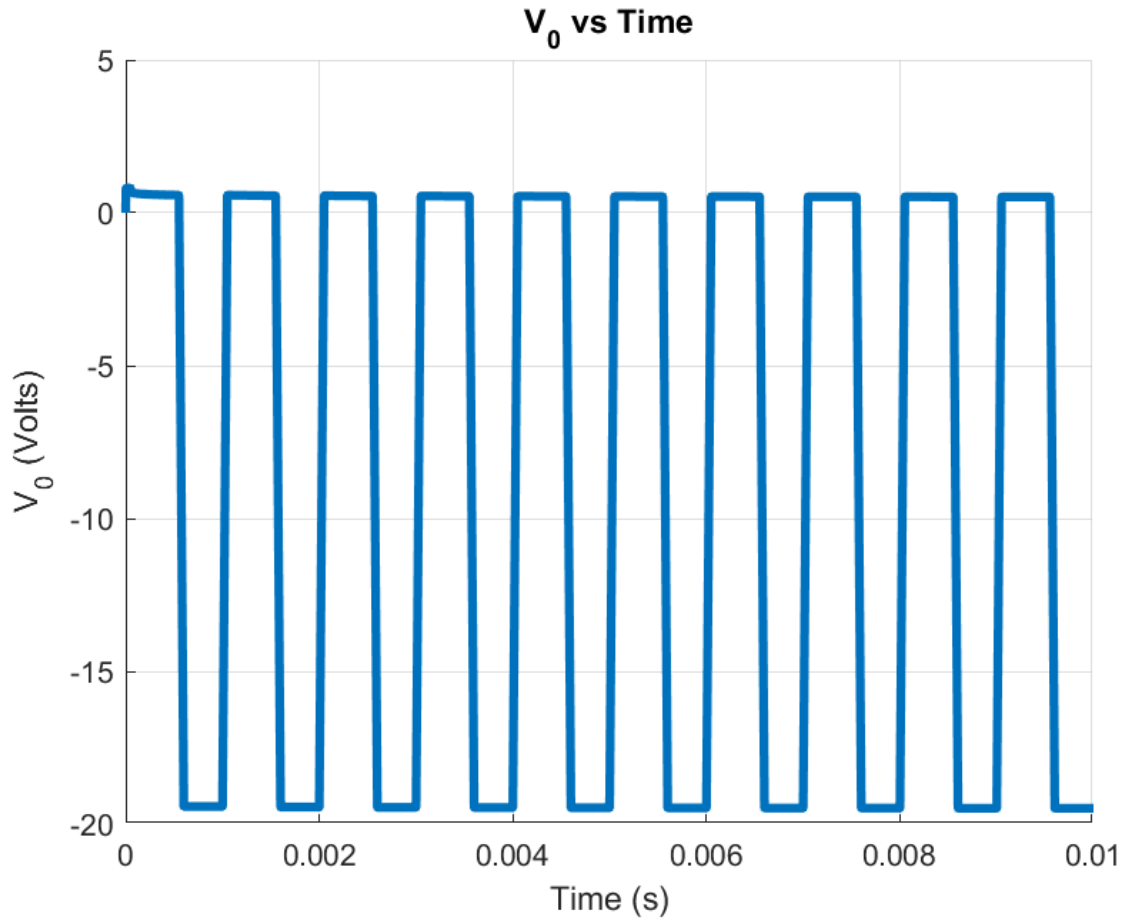


Figure 8: Diode clamper circuit simulation plot (Square wave input)

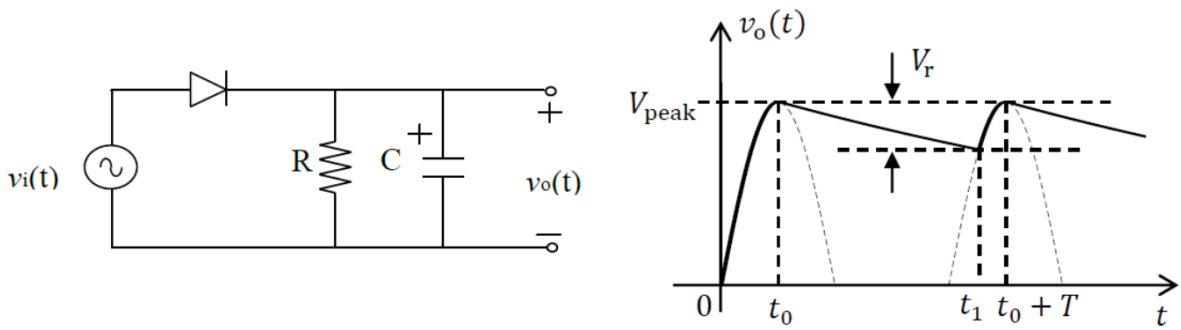


Figure 9: Half-wave rectifier circuit schematic for the Step 6

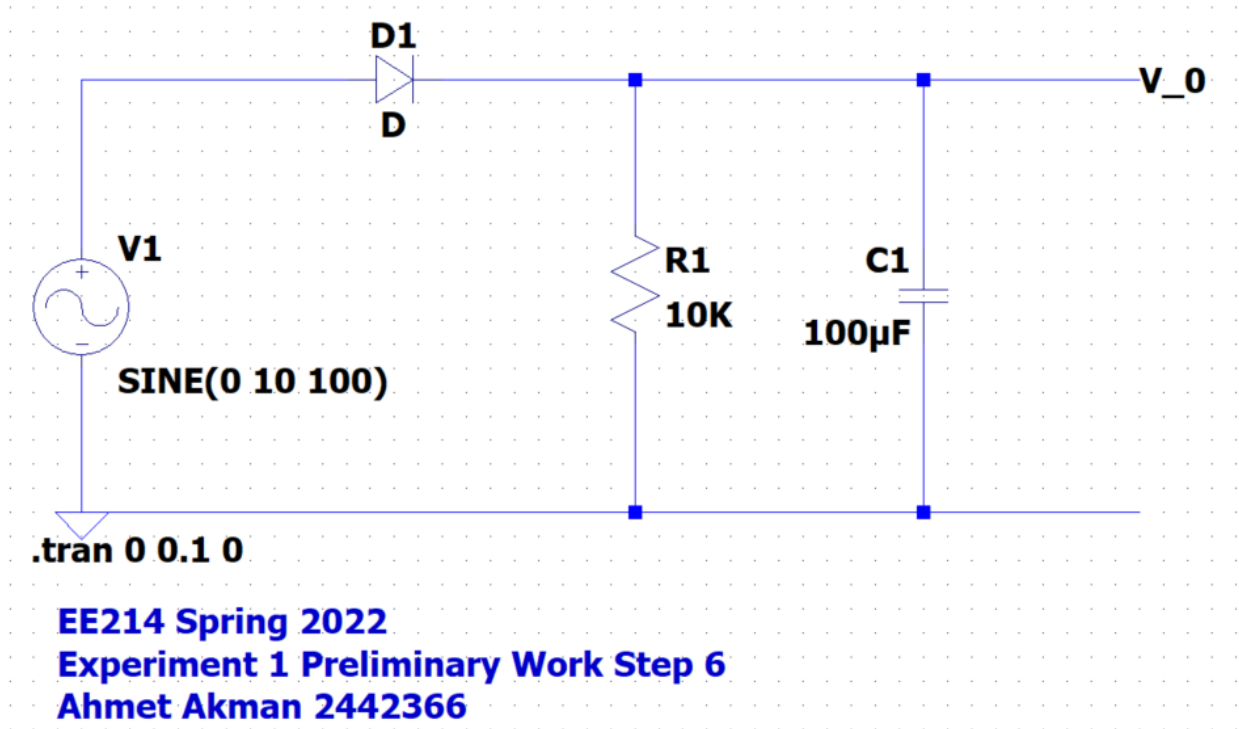


Figure 10: Half-wave rectifier circuit simulation schematic for the Step 6

6.3 a)

6.4 b)

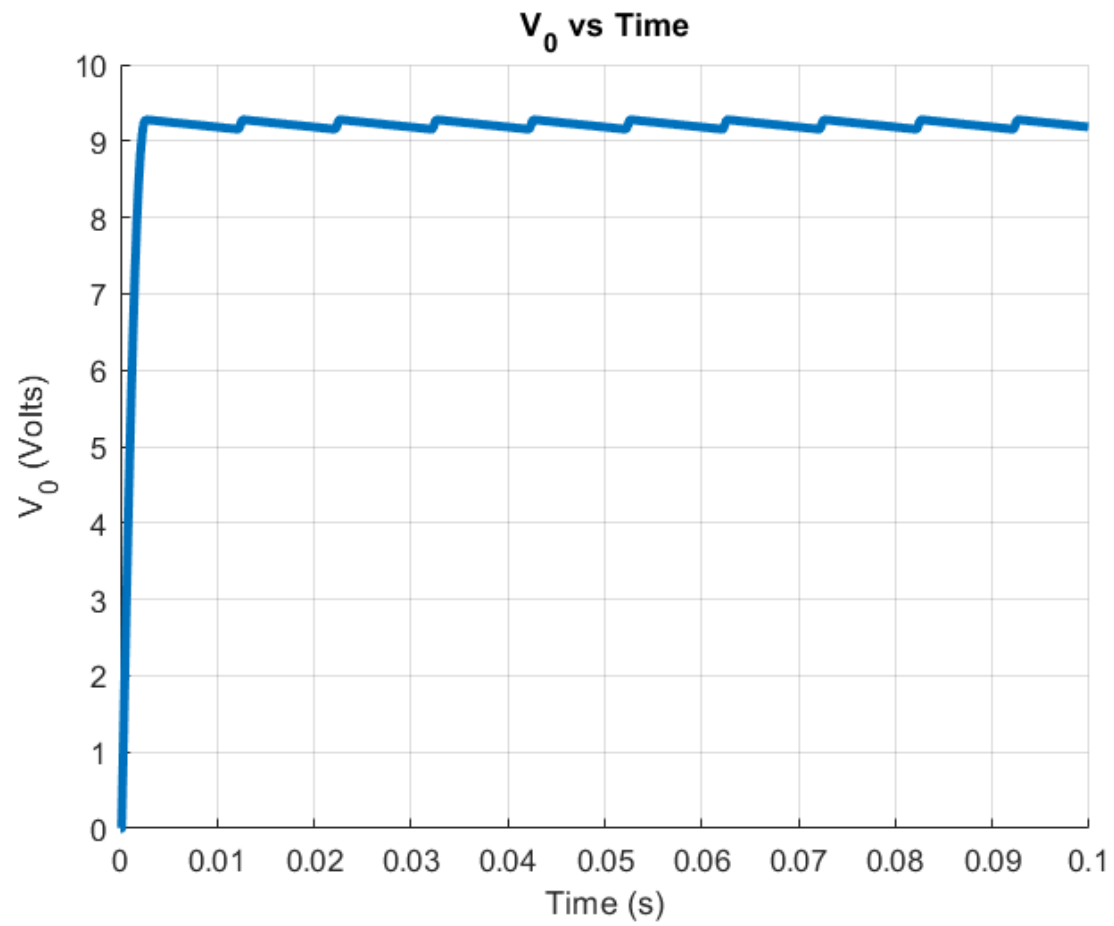


Figure 11: Half wave rectifier circuit simulation plot V_o

6.5 c)

7 Step 7

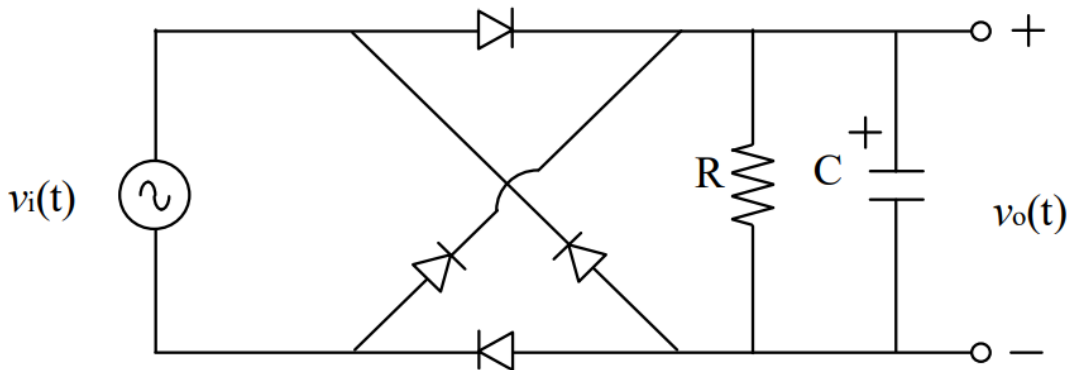


Figure 12: Full-wave rectifier circuit schematic for the Step 7

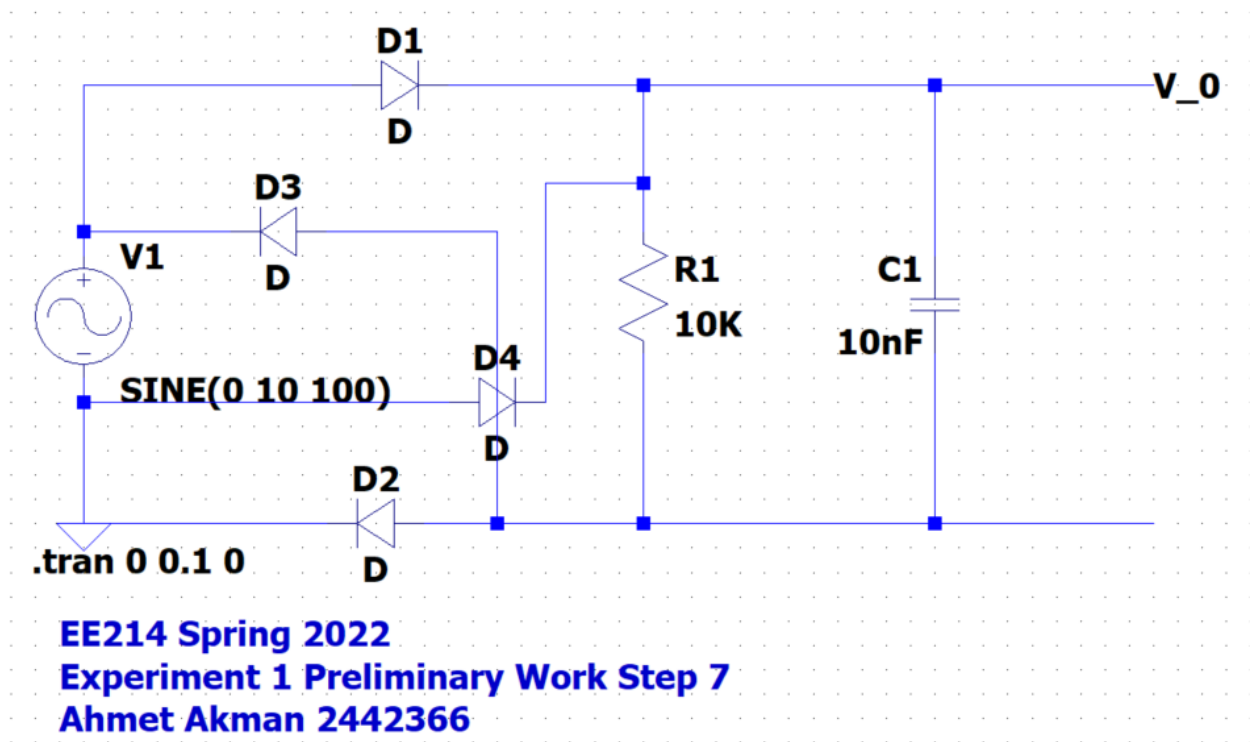


Figure 13: Full-wave rectifier circuit simulation schematic for the Step 7

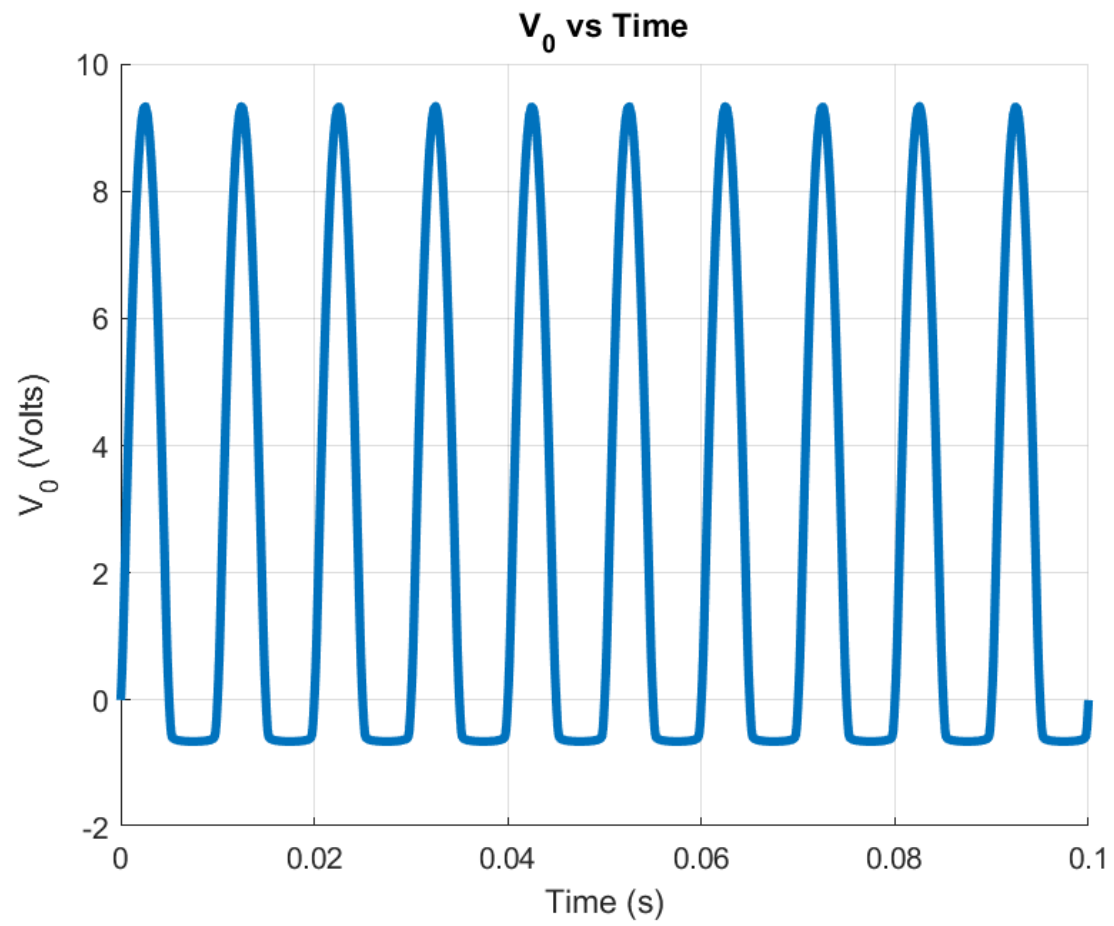


Figure 14: Full-wave rectifier circuit simulation plot V_o — no capacitor

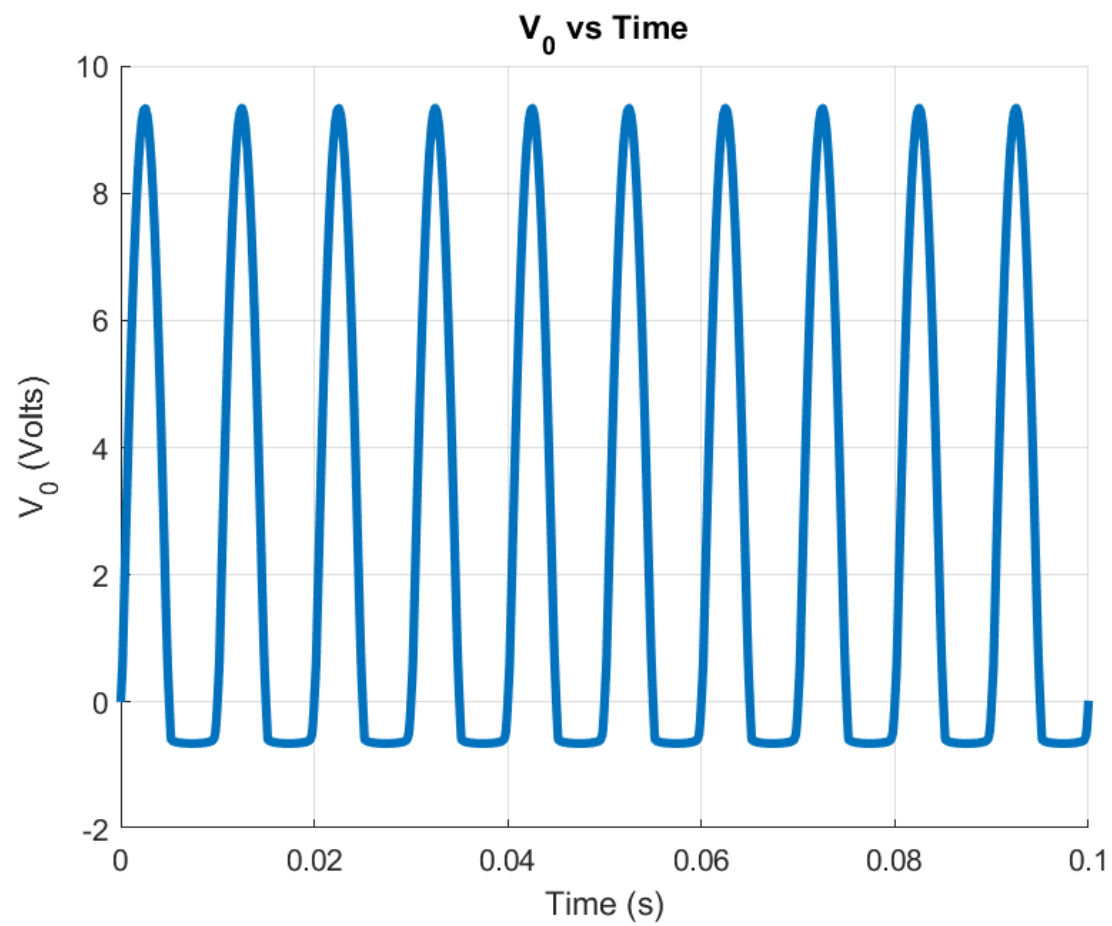


Figure 15: Full-wave rectifier circuit simulation plot V_o — 10nF capacitor

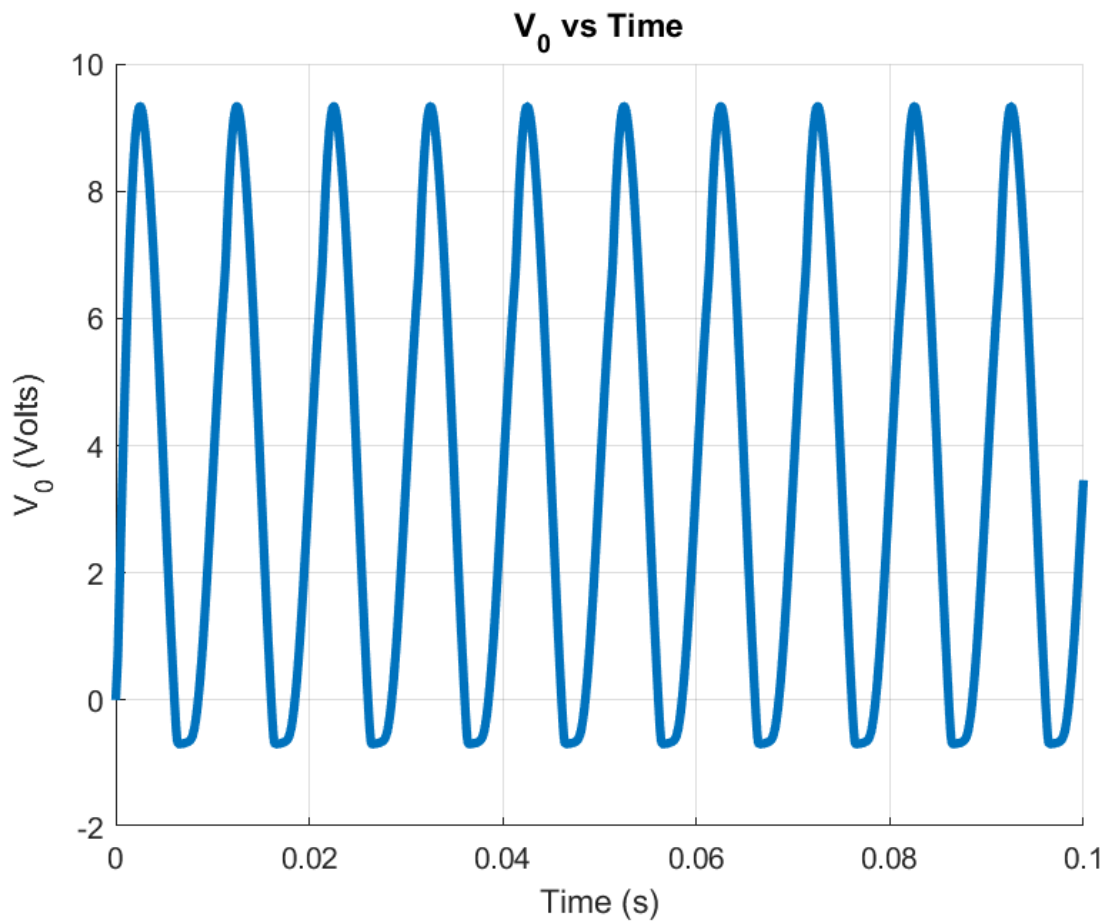


Figure 16: Full-wave rectifier circuit simulation plot V_o — 1uF capacitor

8 Step 8

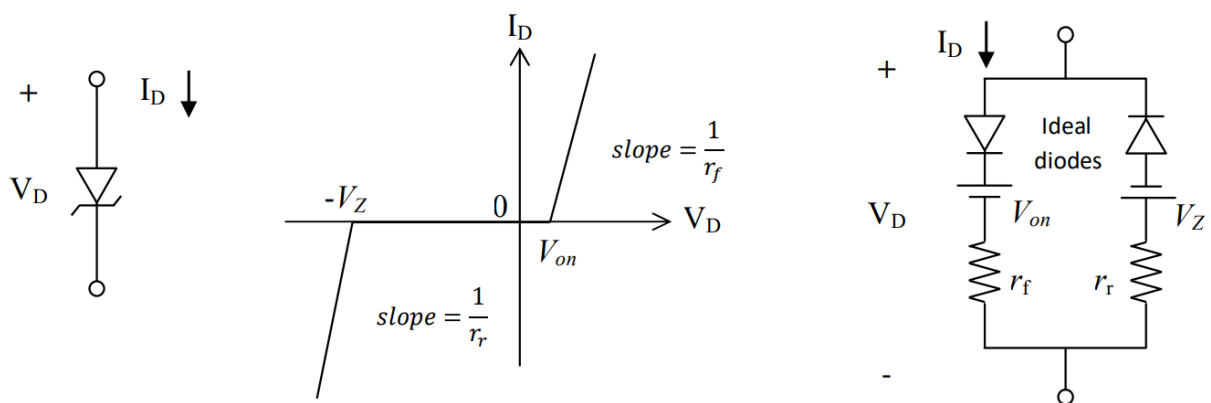


Figure 17: Common piecewise linear model for a zener diode.

9 Step 9

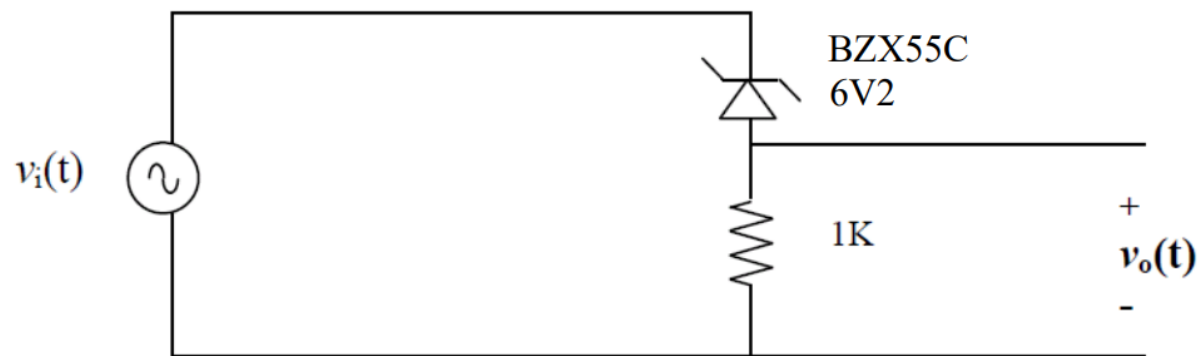


Figure 18: DC level shifter circuit schematic for the Step 9

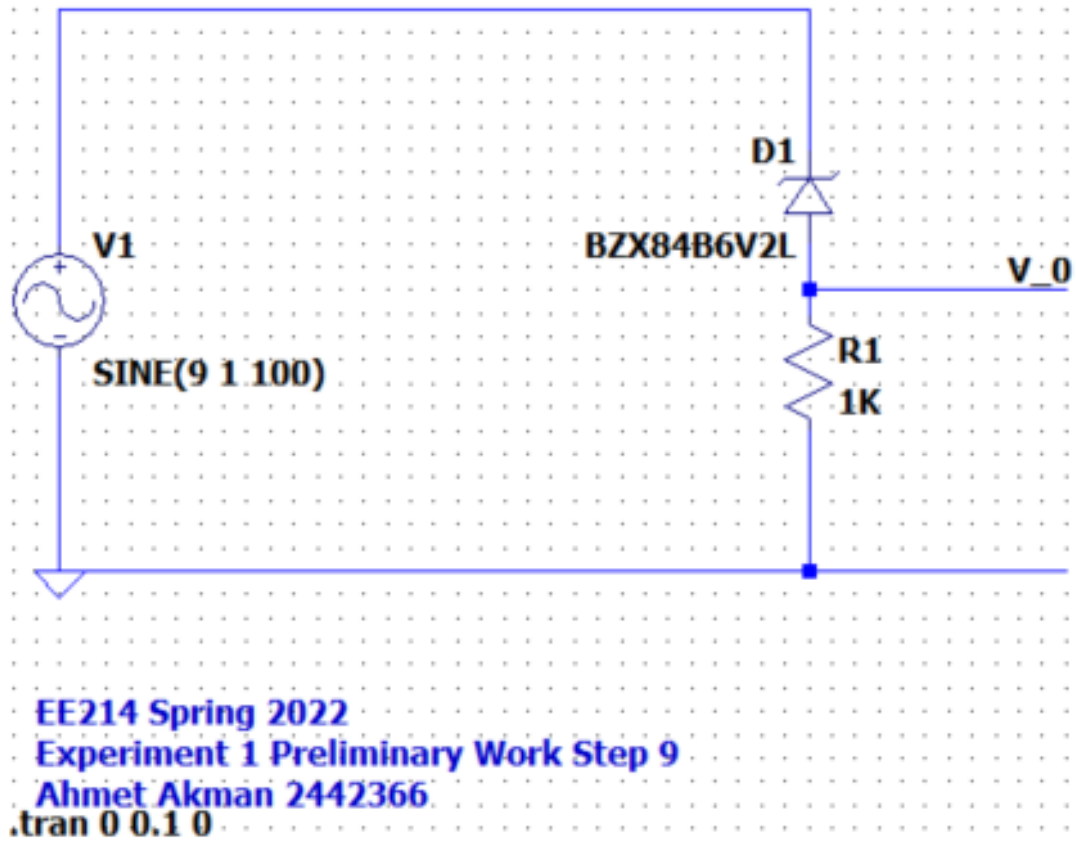


Figure 19: DC level shifter circuit simulation schematic for the Step 9

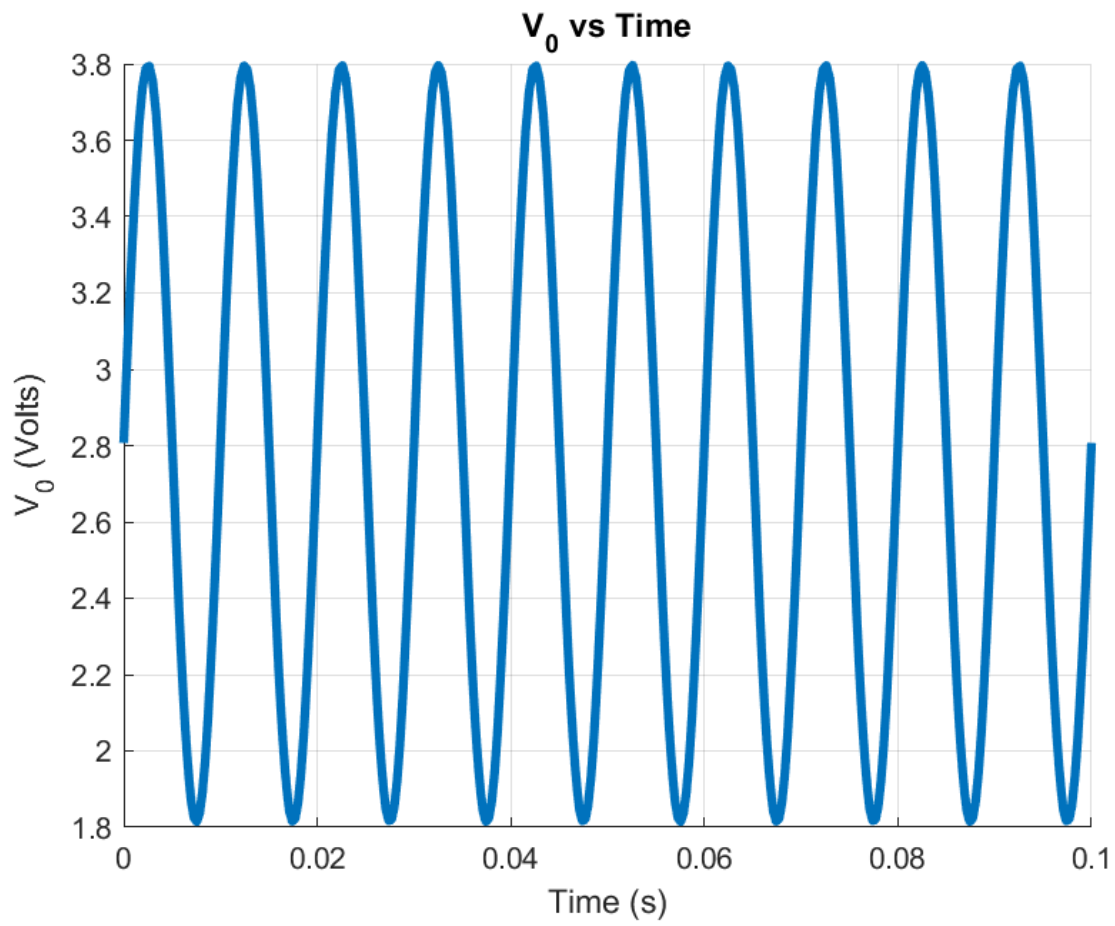


Figure 20: DC level shifter circuit simulation plot V_0

10 Step 10

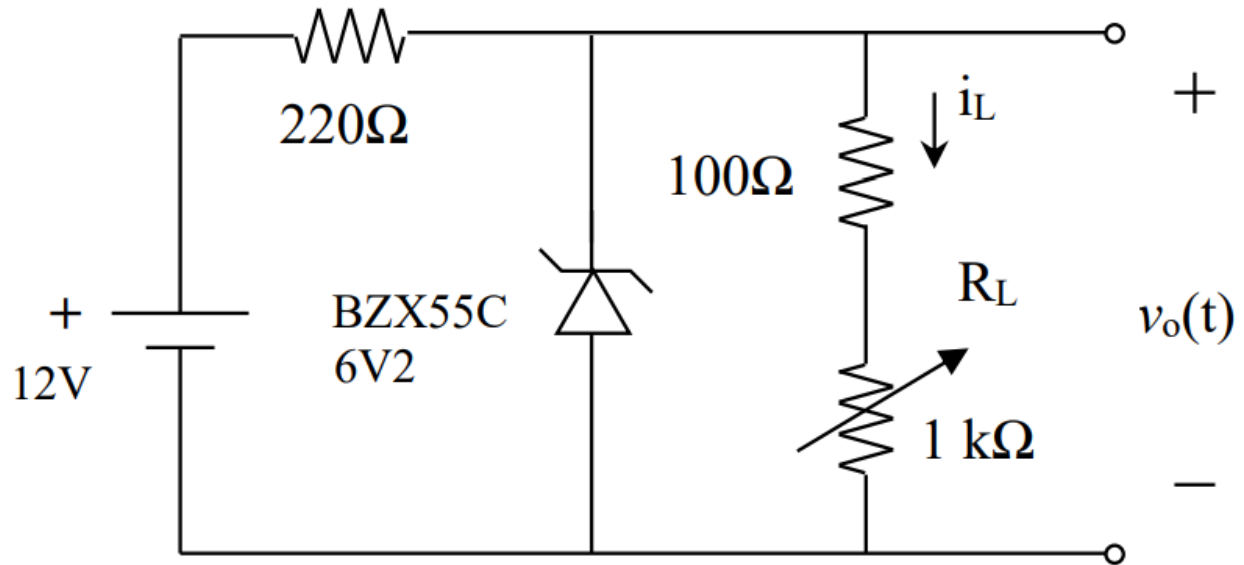


Figure 21: Regulation with zener diode circuit schematic for the Step 10

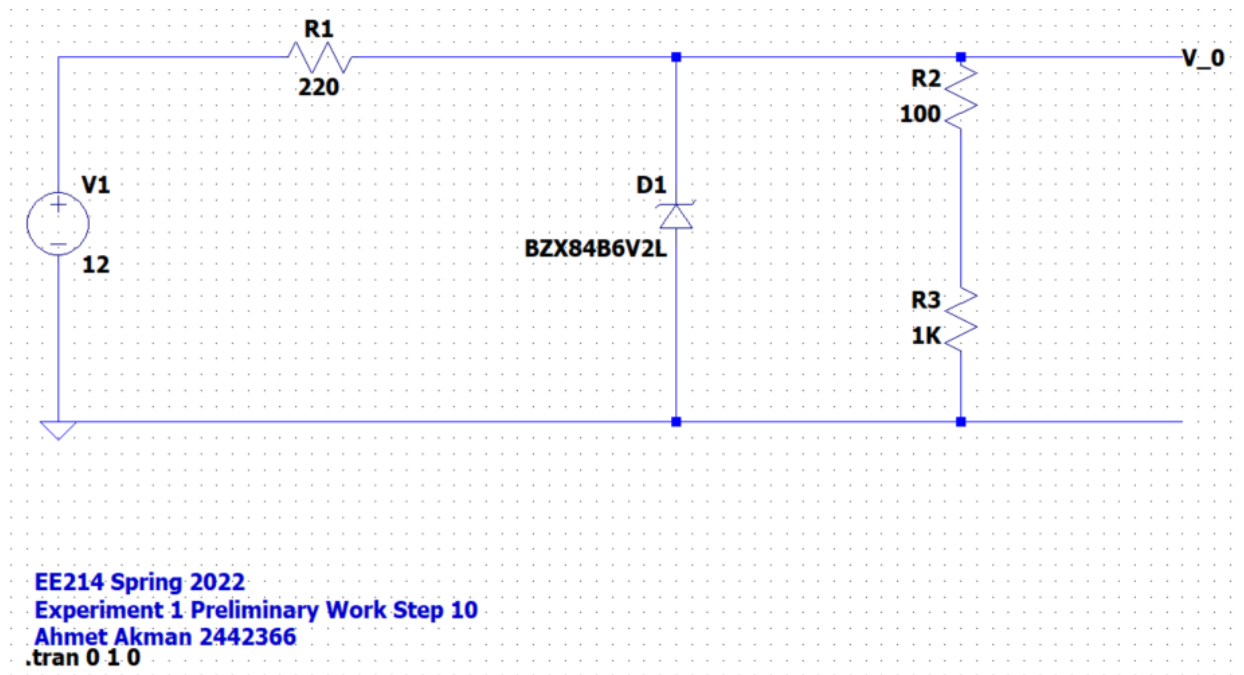


Figure 22: Regulation with zener diode circuit simulation schematic for the Step 10

11 Step 11

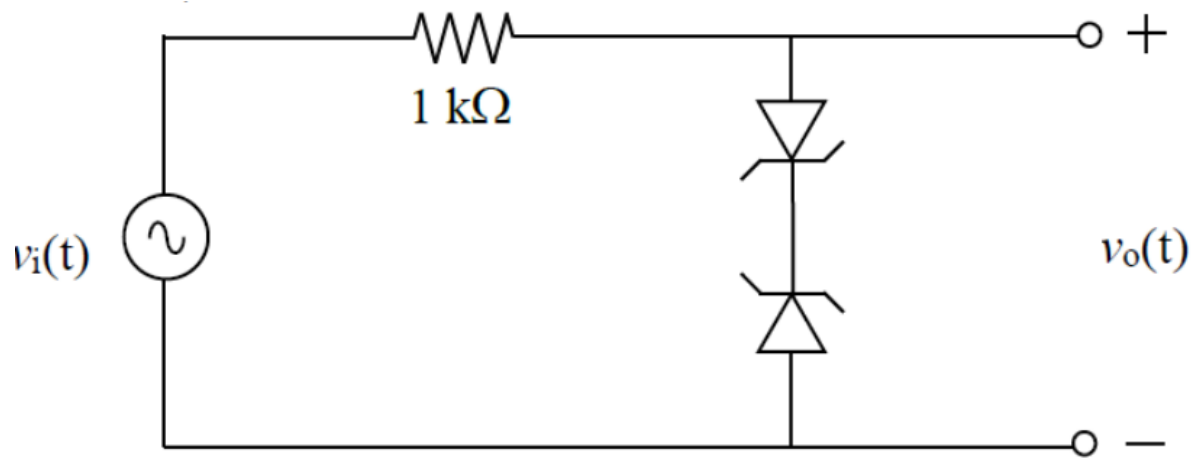


Figure 23: Clipper circuit schematic for the Step 11

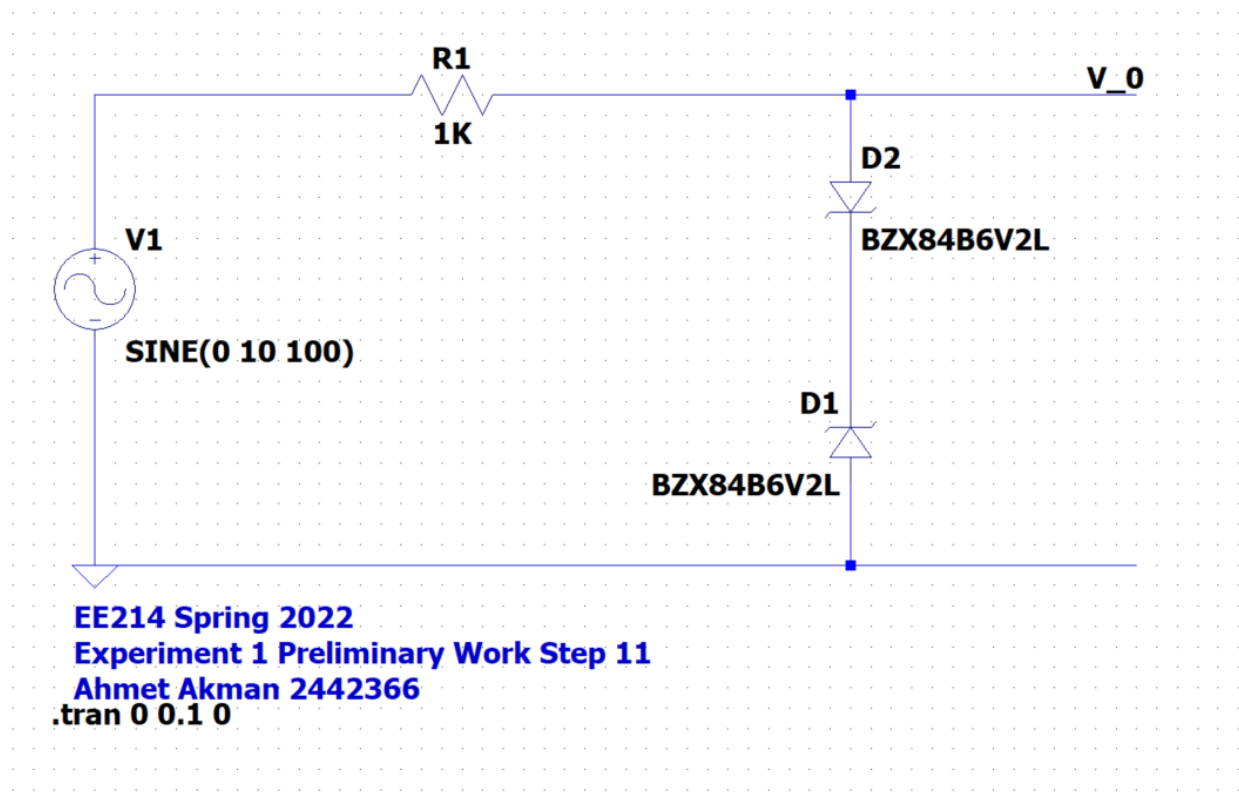


Figure 24: Clipper circuit simulation schematic for the Step 11

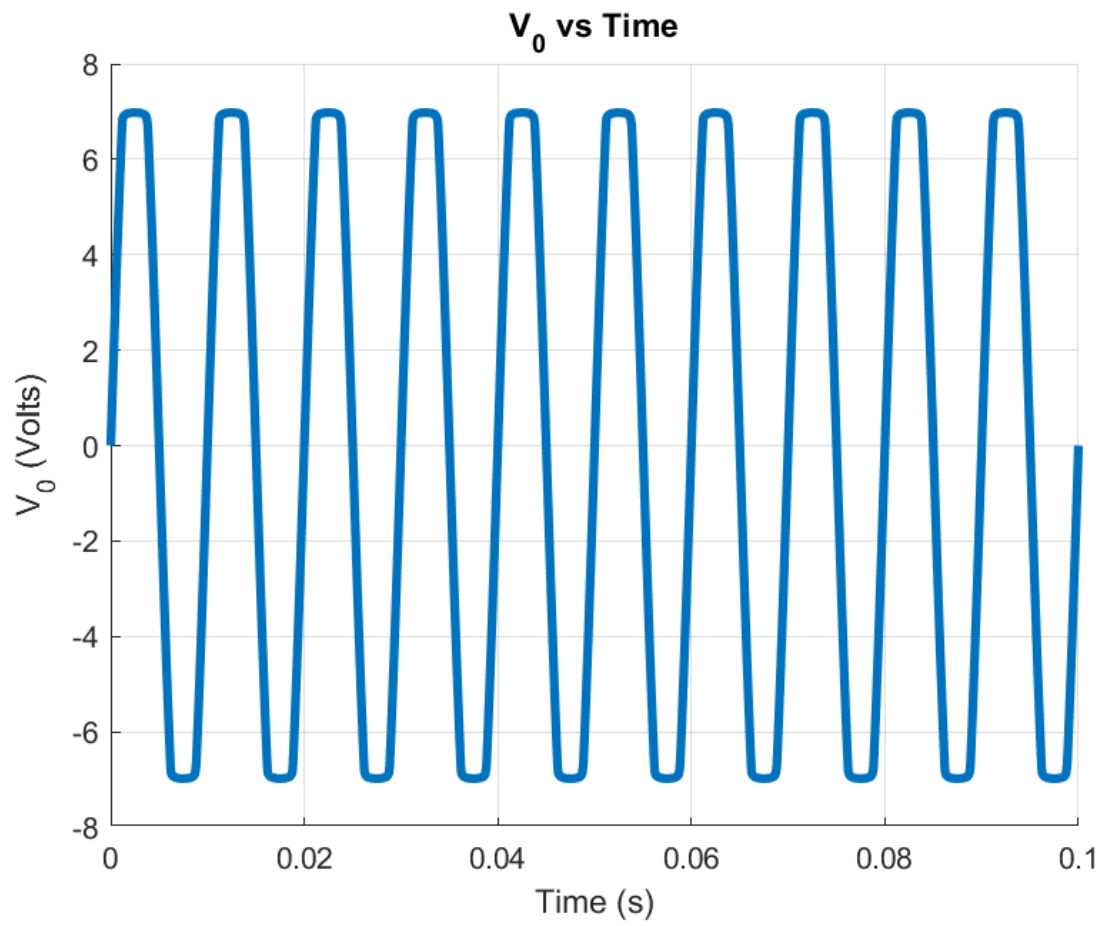


Figure 25: Clipper circuit simulation plot V_o

12 Conclusion